

Serial No: 10/010721

Examiner: A. Psitos

Title: RELIEF DIFFRACTION GRATING BODY, AND OPTICAL PICK-UP AND OPTICAL INFORMATION APPARATUS  
USING SAME

**Amendments to the Claims:**

This listing of claims will replace all prior versions and listings of claims in the application.

**Listing of Claims:**

1. (canceled)
2. (canceled)
3. (canceled)
4. (canceled)
5. (canceled)
6. (withdrawn) The diffraction grating body according to claim 1, further comprising an anti-reflection film in the interface between the base material having a refractive index  $n_1$  and the air, and the interface between the base material having the refractive index  $n_1$  and the base material having a refractive index  $n_0$ .
7. (currently amended) A ~~transmission~~ diffraction grating body, comprising a base material, and a relief diffraction grating formed on the base material, wherein  
~~the diffraction grating body is formed of a single base material; and the~~  
refractive index  $n_1$  of the ~~single~~ base material is 1.9 or more,  
the diffraction grating is formed of a concave portion and a convex portion having rectangular shaped cross sections, and the level difference  $h$  between the concave portion and the convex portion satisfies the following relationship:  
$$h = \lambda_1 / (n_1 - 1)$$
and the difference in an optical path between the concave portion and the convex portion is set to correspond to one wavelength with respect to the wavelength  $\lambda_1$ , and  
a material of the single base material is at least one material selected from the group consisting of  $Ta_2O_5$ ,  $[TiO_2]$ ,  $ZrO_2$ ,  $Nb_2O_3$ ,  $ZnS$ ,  $LiNbO_3$  and  $LiTaO_3$ .

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8. (canceled)

9. (canceled)

10. (canceled)

11. (canceled)

12. (canceled)

13. (canceled)

14. (canceled)

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15. (currently amended) A semiconductor laser apparatus ~~provided with a diffraction grating body according to claim 7~~, comprising:

a diffraction grating body, comprising a base material, and a relief diffraction grating formed on the base material, wherein

the refractive index  $n_1$  of the base material is 1.9 or more,

the diffraction grating is formed of a concave portion and a convex portion having rectangular shaped cross sections, and the level difference  $h$  between the concave portion and the convex portion satisfies the following relationship:

$$h = \lambda_1 / (n_1 - 1)$$

and the difference in an optical path between the concave portion and the convex portion is set to correspond to one wavelength with respect to the wavelength  $\lambda_1$ , and

a material of the base material is at least one material selected from the group consisting of  $Ta_2O_5$ ,  $[TiO_2]$ ,  $ZrO_2$ ,  $Nb_2O_5$ ,  $ZnS$ ,  $LiNbO_3$  and  $LiTaO_3$ ;

a semiconductor laser for emitting a light beam with wavelength  $\lambda_1$  and a light beam with wavelength  $\lambda_2$ ; and

a photodetector for receiving the light beams emitted from the semiconductor laser and carrying out photoelectric conversion; wherein

the diffraction grating body receives the light beam with wavelength  $\lambda_2$  and transmits a main beam and generates sub-beams that are  $\pm$  first order diffracted light; and

the diffraction grating body, the semiconductor laser and the photodetector are integrated into one package.

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~~1416.~~ (currently amended) An optical pick-up ~~provided with a diffraction grating body~~  
according to claim 7, comprising:

a diffraction grating body, comprising a base material, and a relief diffraction  
grating formed on the base material, wherein

the refractive index  $n_1$  of the base material is 1.9 or more,

the diffraction grating is formed of a concave portion and a convex portion  
having rectangular shaped cross sections, and the level difference  $h$  between the  
concave portion and the convex portion satisfies the following relationship:

$$h = \lambda_1 / (n_1 - 1)$$

and the difference in an optical path between the concave portion and the convex  
portion is set to correspond to one wavelength with respect to the wavelength  $\lambda_1$ , and

a material of the base material is at least one material selected from  
the group consisting of  $Ta_2O_5$ ,  $[(TiO_2)]$ ,  $ZrO_2$ ,  $Nb_2O_5$ ,  $ZnS$ ,  $LiNbO_3$  and  $LiTaO_3$ ;

a first semiconductor laser light source for emitting a light beam with  
wavelength  $\lambda_1$ ;

a second semiconductor laser light source for emitting a light beam with  
wavelength  $\lambda_2$ ;

an optical system having an optical disk, the optical system for receiving the light  
beam with wavelength  $\lambda_1$  and the light beam with wavelength  $\lambda_2$  and converging the  
light beam onto a microspot on the optical disk;

a diffraction means for diffracting a light beam reflected from the optical disk;

and

a photodetector having a photo detecting portion for receiving the diffracted  
light diffracted by the diffraction means to output electrical signals in accordance with  
the amount of the diffracted light; wherein

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the diffraction grating body receives the light beam with wavelength  $\lambda_2$  and transmits a main beam and generates sub-beams that are  $\pm$  first order diffracted light.

17. (new) The optical pick-up according to claim 16, wherein the photo detecting portion comprises a photo detecting portion PD0 for receiving a  $\pm$  first order diffracted light from the diffraction means, and a distance d1 between the center of the photo detecting portion PD0 and the light emitting spot of the first semiconductor laser light source and a distance d2 between the center of the photo detecting portion PD0 and the light emitting spot of the second semiconductor laser light source substantially satisfy the following relationship:

$$\lambda_1/\lambda_2=d1/d2.$$

18. (new) The optical pick-up according to claim 16, wherein the diffraction grating body, the semiconductor laser and the photodetector are integrated into one package.

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19. (new) An optical information apparatus, comprising:

an optical pick-up, comprising:

a diffraction grating body, comprising a base material, and a relief diffraction grating formed on the base material, wherein the refractive index  $n_1$  of the base material is 1.9 or more, the diffraction grating is formed of a concave portion and a convex portion having rectangular shaped cross sections, and the level difference  $h$  between the concave portion and the convex portion satisfies the following relationship:

$$h = \lambda_1 / (n_1 - 1)$$

and the difference in an optical path between the concave portion and the convex portion is set to correspond to one wavelength with respect to the wavelength  $\lambda_1$ , and

a material of the base material is at least one material selected from the group consisting of  $Ta_2O_5$ ,  $ZrO_2$ ,  $Nb_2O_3$ ,  $ZnS$ ,  $LiNbO_3$  and  $LiTaO_3$ ;

a first semiconductor laser light source for emitting a light beam with wavelength  $\lambda_1$ ;

a second semiconductor laser light source for emitting a light beam with wavelength  $\lambda_2$ ;

an optical system having an optical disk, the optical system for receiving the light beam with wavelength  $\lambda_1$  and the light beam with wavelength  $\lambda_2$  and converging the light beams onto a microspot on the optical disk;

a diffraction means for diffracting a light beam reflected from the optical disk;

a photodetector having a photo detecting portion for receiving the diffracted light diffracted by the diffraction means to output electrical signals in accordance with

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the amount of the diffracted light; wherein

the diffraction grating body receives the light beam with wavelength  $\lambda_2$  and transmits a main beam and generates sub-beams that are  $\pm$  first order diffracted light;

a focusing control means for focusing the light beams on the optical disk;

a tracking control means for tracking the light beams on the optical disk; and

an information signal detecting means for detecting the output electrical signals;

and further comprising:

a moving means for moving the optical pick-up; and

a rotating means for rotating the optical disk.